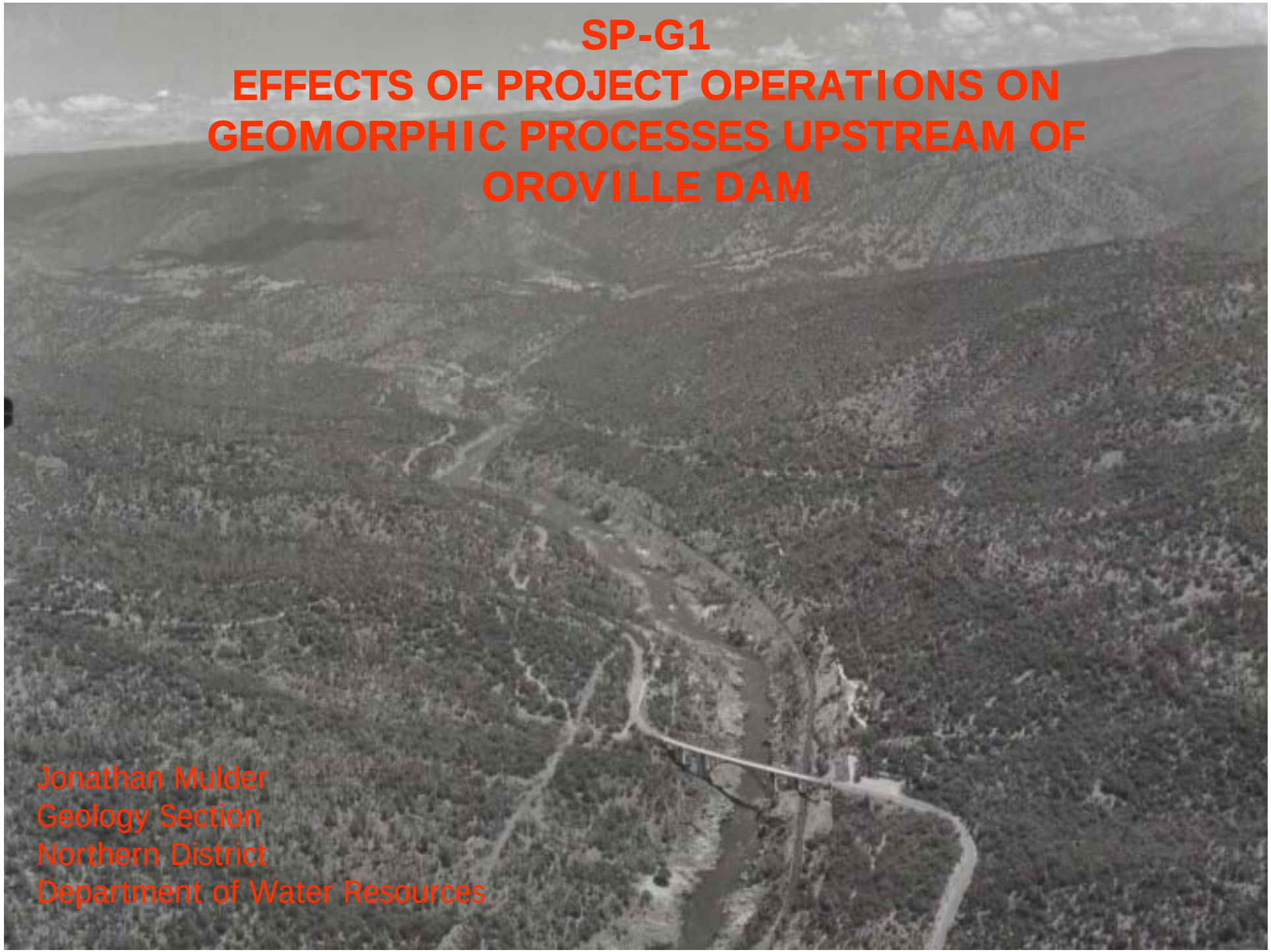

SP-G1
EFFECTS OF PROJECT OPERATIONS ON GEOMORPHIC PROCESSES UPSTREAM OF OROVILLE DAM

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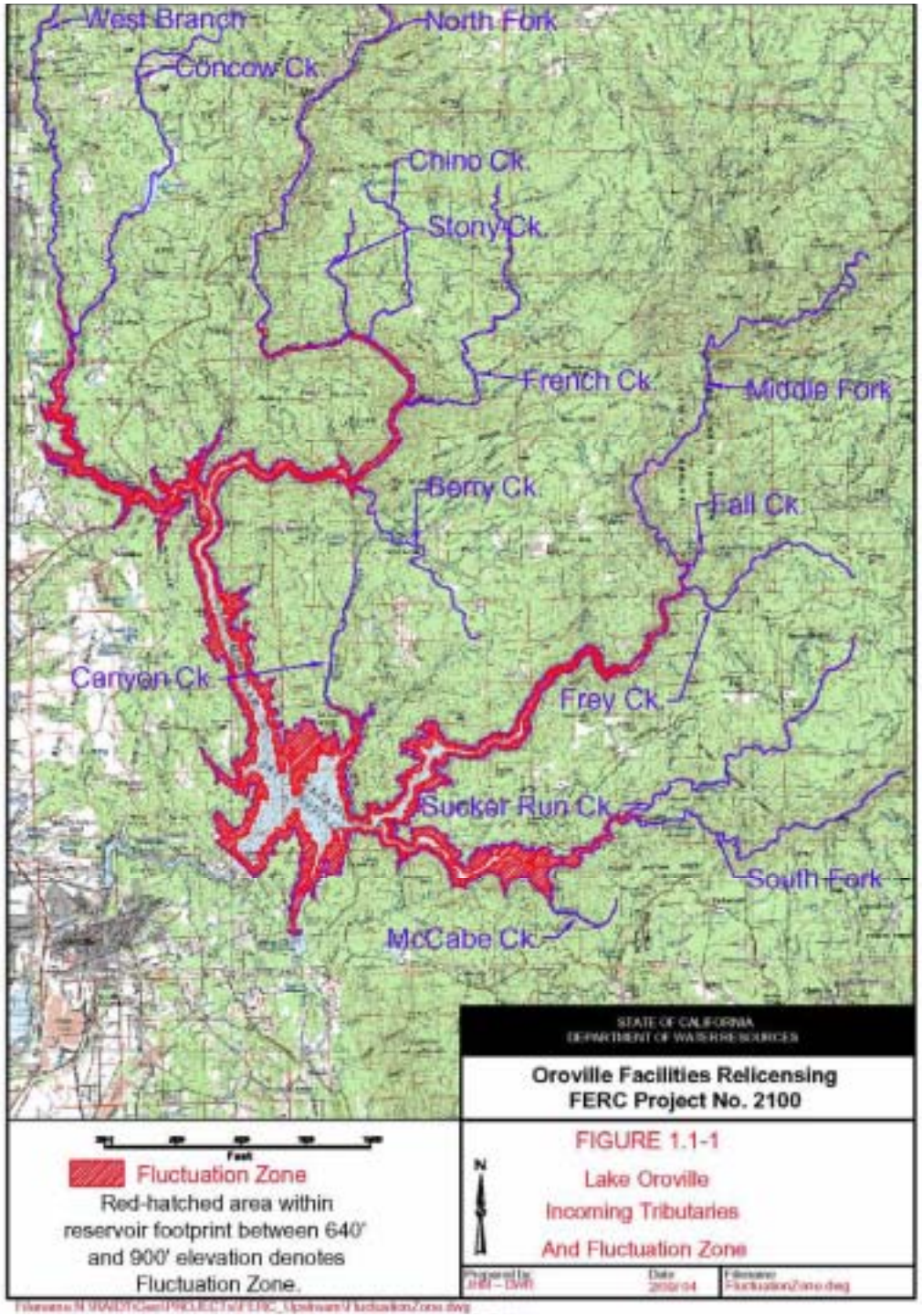
Northern District
Department of Water Resources

Two Primary Tasks

- Assess Channel Resources
- Determine total sediment in Storage
  - Re-Survey Cross Sections
  - Thalweg Bathymetry Survey
  - Slope Stability Investigation
  - Shoreline Investigation

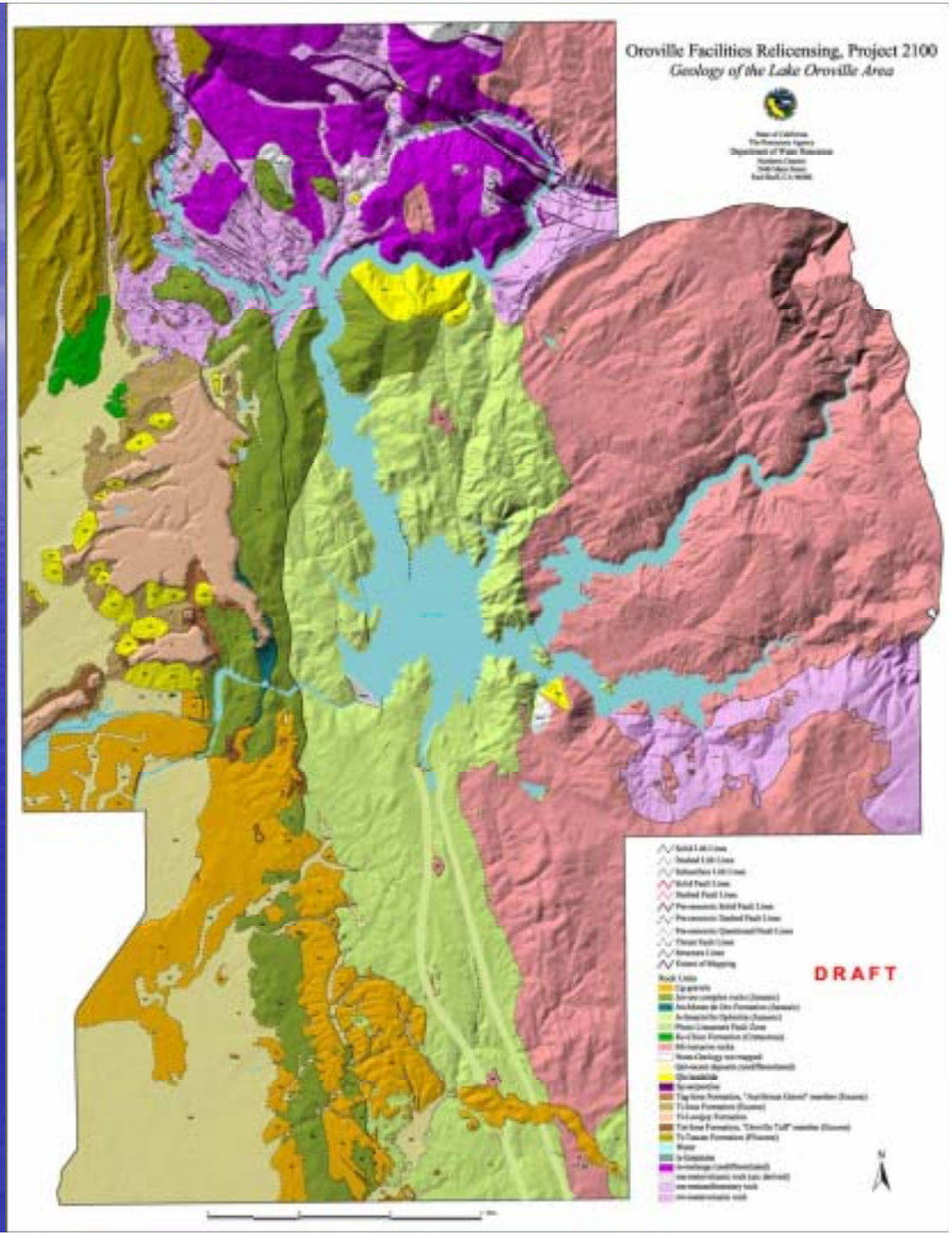
SP-G1 Study Area

- Four major tribs
- Ten smaller tribs
- Fluctuation Zone



Existing Resource Data

- Mapping



Existing Resource Data

- Cross-Section Studies

  1971 – 24 Sections surveyed

  – Concluded minimal sedimentation except for 20’ of fill in uppermost Middle Fork section.

  1993-94 – 17 of 24 Sections surveyed

  – Several conclusions:

    - Sediment erosion in upper sections of Middle and North Forks.
    - Substantial deposition in intermediate sections.
    - Minimal deposition in lower sections due to bank erosion.

Channel Resources

- Initial Stream Classification:

  Rosgen Level I – Type B morphology
  - Moderately entrenched
  - Riffle-run-pool sequences
  - Bedrock control
- Mesohabitat Classification

  Approach developed by SWRI
  - Stream element ratios (riffles, runs, pools, glides
  - Spawning gravel quality
  - Cover

Channel Resources

Separated into two components:

1. Above 900 feet: never inundated.
   - West Branch
   - Middle Fork
2. Below 900 feet: repeated inundations (aka Fluctuation Zone)
   - All four main tribs

Channel Resources Above 900 Feet

- West Branch

15,300 feet mapped.

- 52% pools
- 24% runs
- 15% riffles glides
- 5% cascades
- 4% Miocene reservoir

Spawning gravel assessed as "good to excellent".

Low flows below Miocene Reservoir.

Channel Resources Above 900 Feet

- Middle Fork

14,200 feet mapped.

- 40% pools
- 41% high gradient riffles/riffles
- 9% runs and boulder runs
- 10% cascades

Spawning gravel assessed as "good to excellent" where present.

Channel Resources Within Fluctuation Zone

- West Branch

10,600 feet mapped.

- 70% pools
- 8% riffles/glides
- 12% runs and boulder runs
- 10% cascades

Spawning gravel assessed as "good", but siltier downstream.

Channel Resources Within Fluctuation Zone

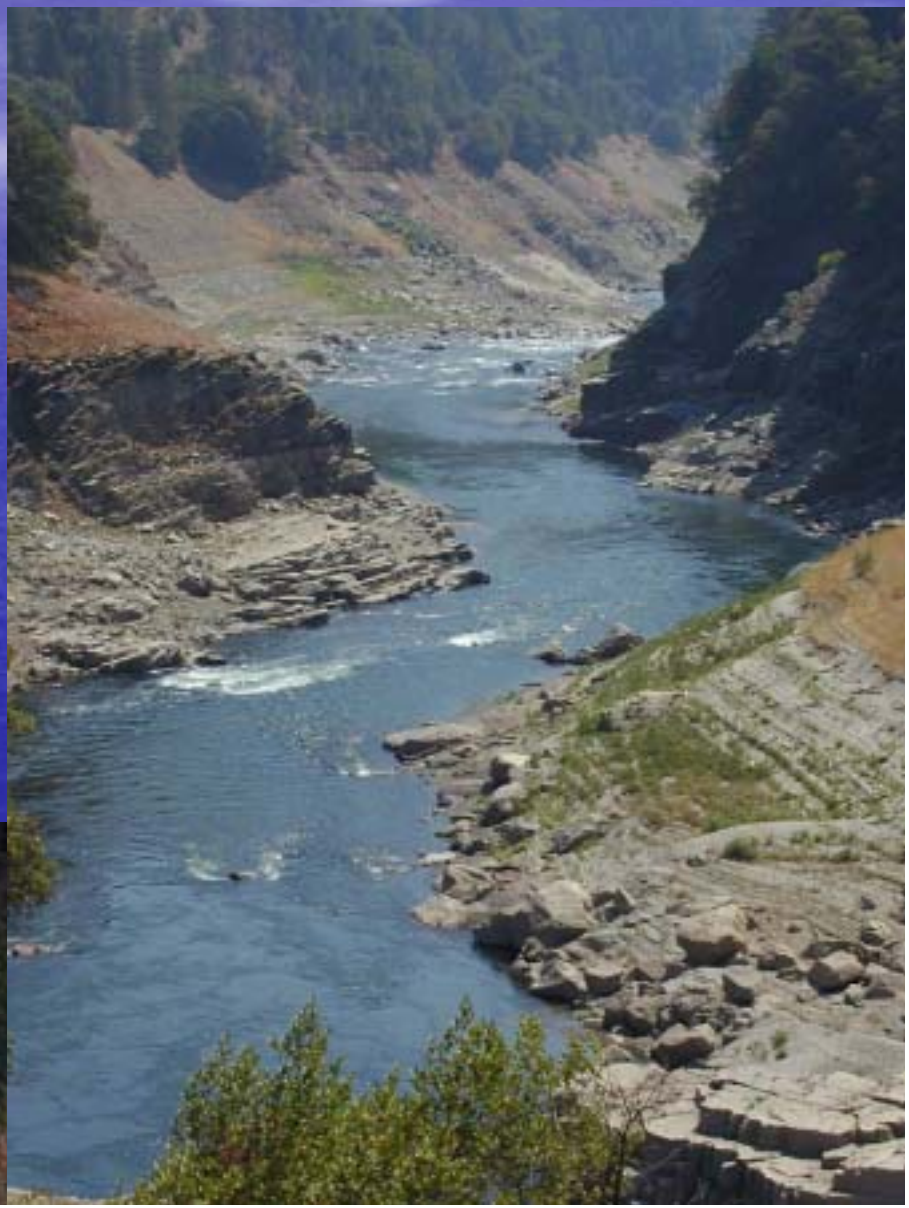
- North Fork

24,000 feet mapped.

  - 3% pools
  - 22% high gradient riffles/riffles
  - 75% runs and boulder runs

Spawning gravel not assessed.I

Dramatic daily flow fluctuations.



Channel Resources Within Fluctuation Zone

- Middle Fork

13,200 feet mapped.

- 24% pools
- 25% glides/riffles
- 43% runs
- 7% cascades

Spawning gravel assessed as "good to excellent".

Natural flows.

Channel Resources Within Fluctuation Zone

- South Fork

8,500 feet mapped.

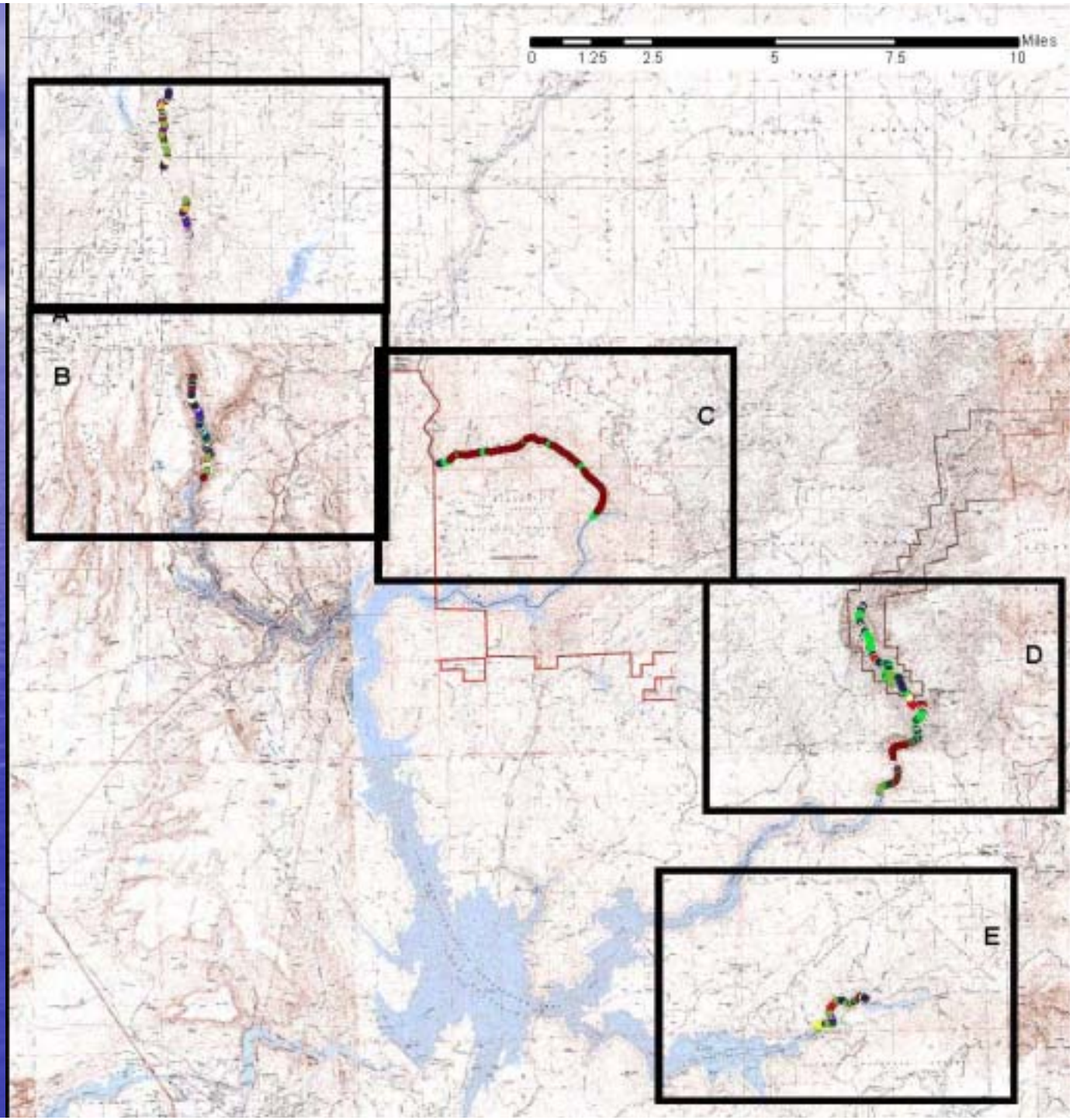
  - 34% pools
  - 41% glides/riffles
  - 10% runs
  - 4% cascades

Spawning gravel assessed as “good to excellent”.

Gravel starved above Sucker Run Creek.

Fluctuating flows from Ponderosa Reservoir.

Channel Resources Mesohabitat Mapping

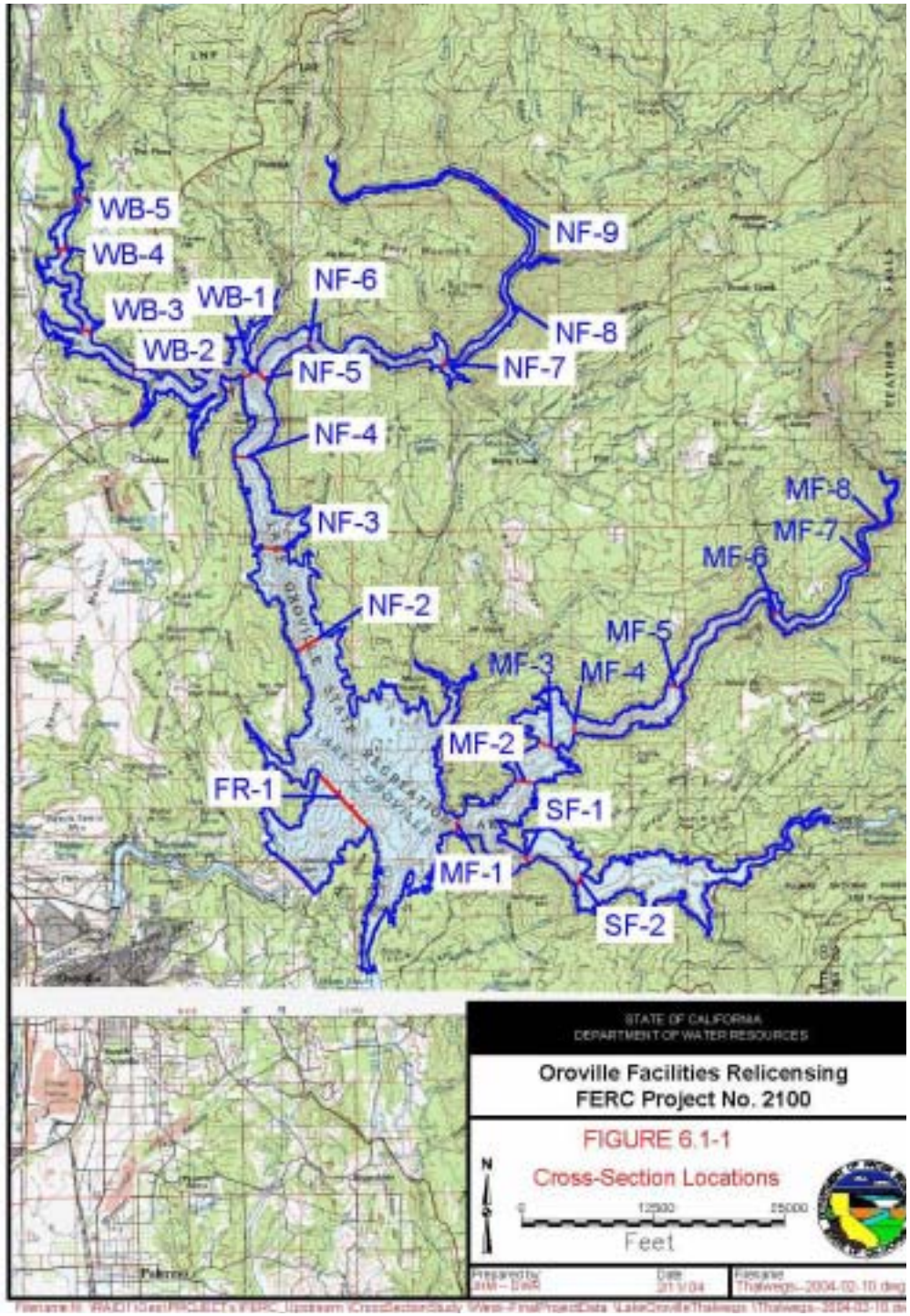


Channel Resources -- Conclusions

- Impacts above 900 feet (West Branch and Middle Fork) due to project operations were not observed.
- Fluctuation Zone Conclusions
  - West Branch “good” spawning gravel but silt accumulation downstream causes a degradation in spawning gravel quality.
  - Salmon spawning habitat in the North Fork is affected because of daily fluctuating flows from upstream hydroelectric facilities.
  - Middle Fork has abundant gravel sources from remnant sediment wedge lag deposits.
  - South Fork is gravel-starved above Sucker Run Creek and is subject to flow variations due to Ponderosa Dam. Spawning gravel quality improves downstream of Sucker Run Creek but gradually becomes sandier from remnant sediment wedge deposits.

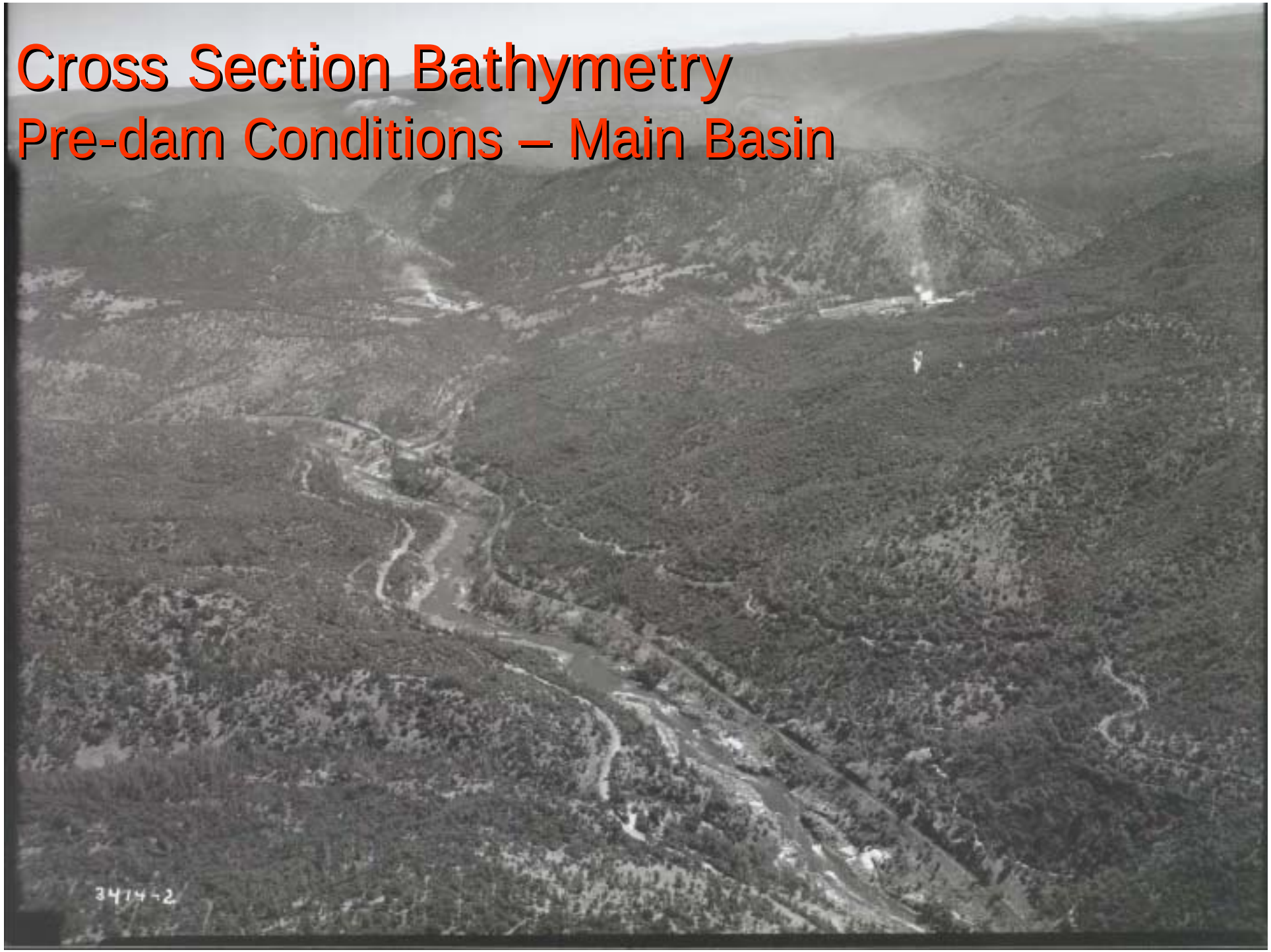
Cross Section Bathymetry

- 5 West Branch
- 9 North Fork
- 8 Middle Fork
- 2 South Fork



Cross Section Bathymetry

Pre-dam Conditions – Main Basin

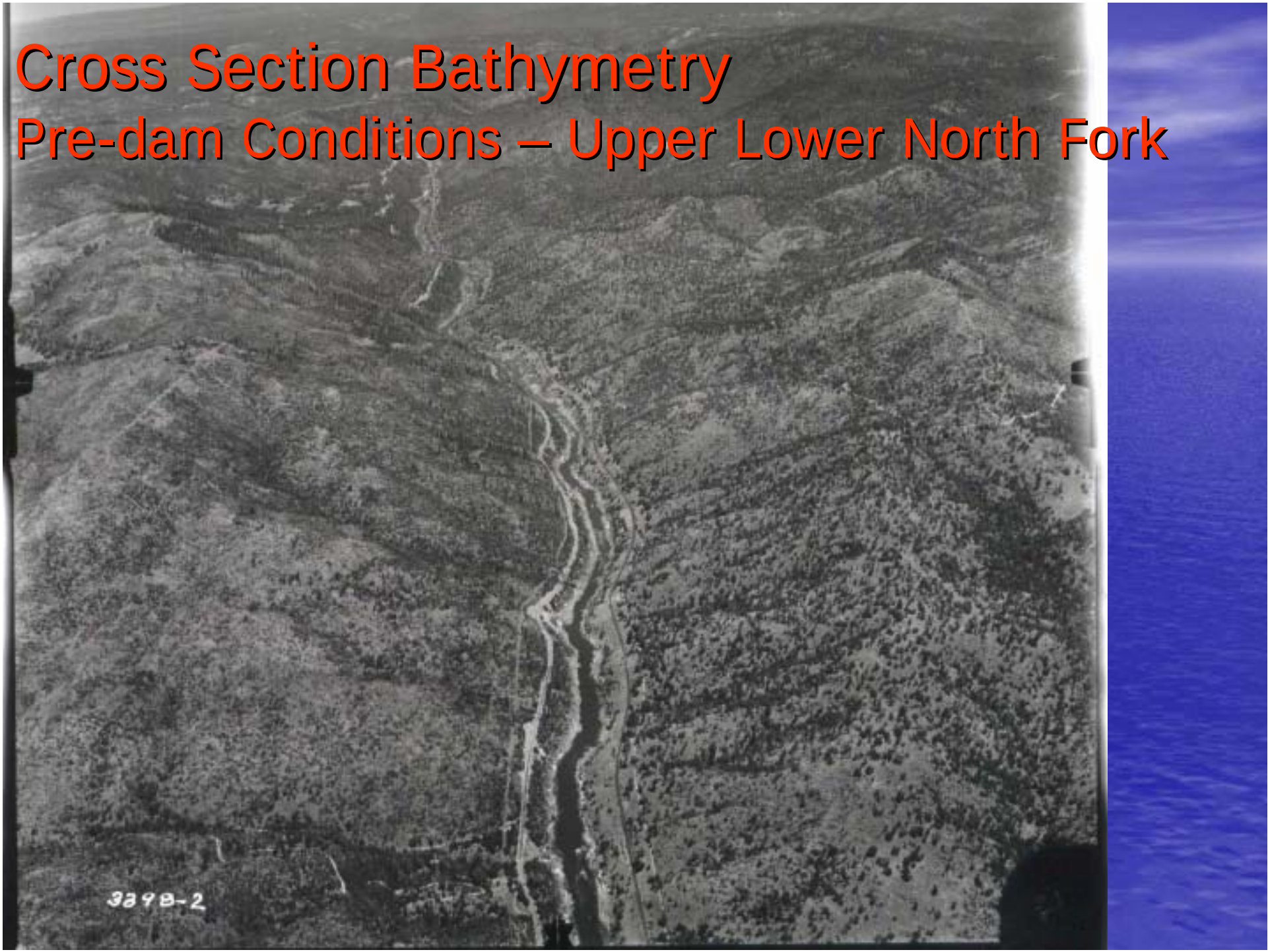


Cross Section Bathymetry

Pre-dam Conditions – Lower North Fork

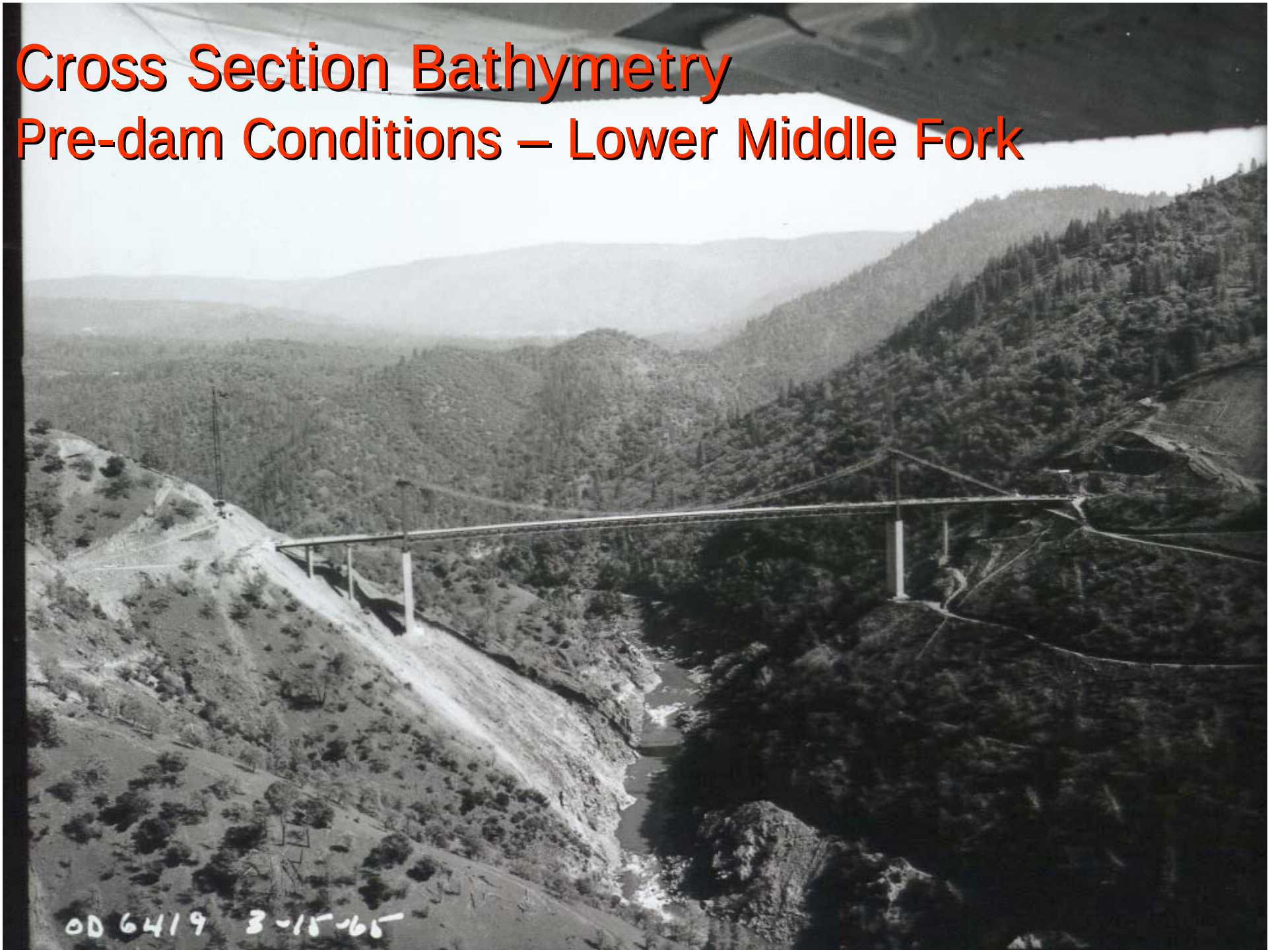
Cross Section Bathymetry

Pre-dam Conditions – Upper Lower North Fork

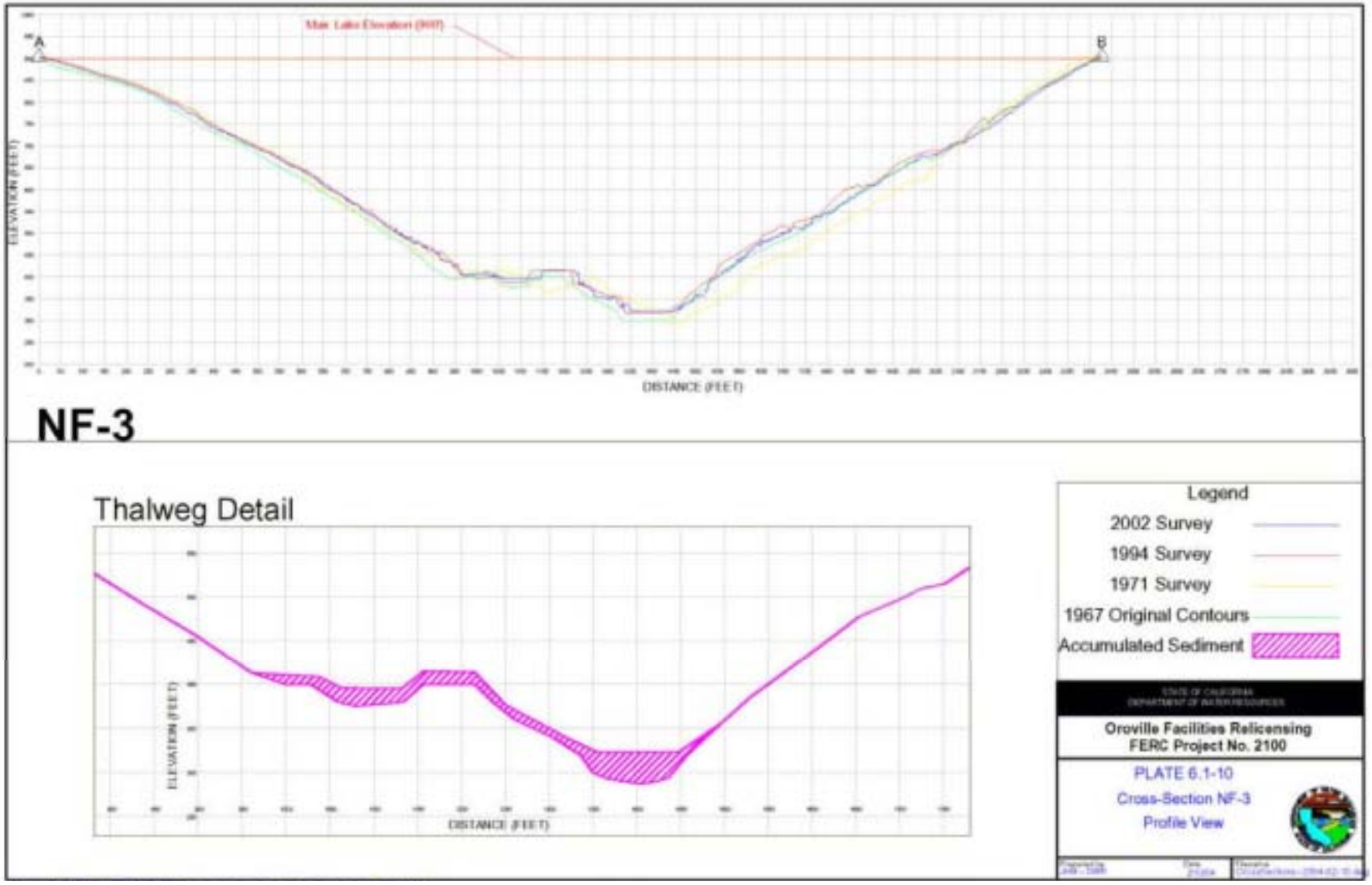


Cross Section Bathymetry

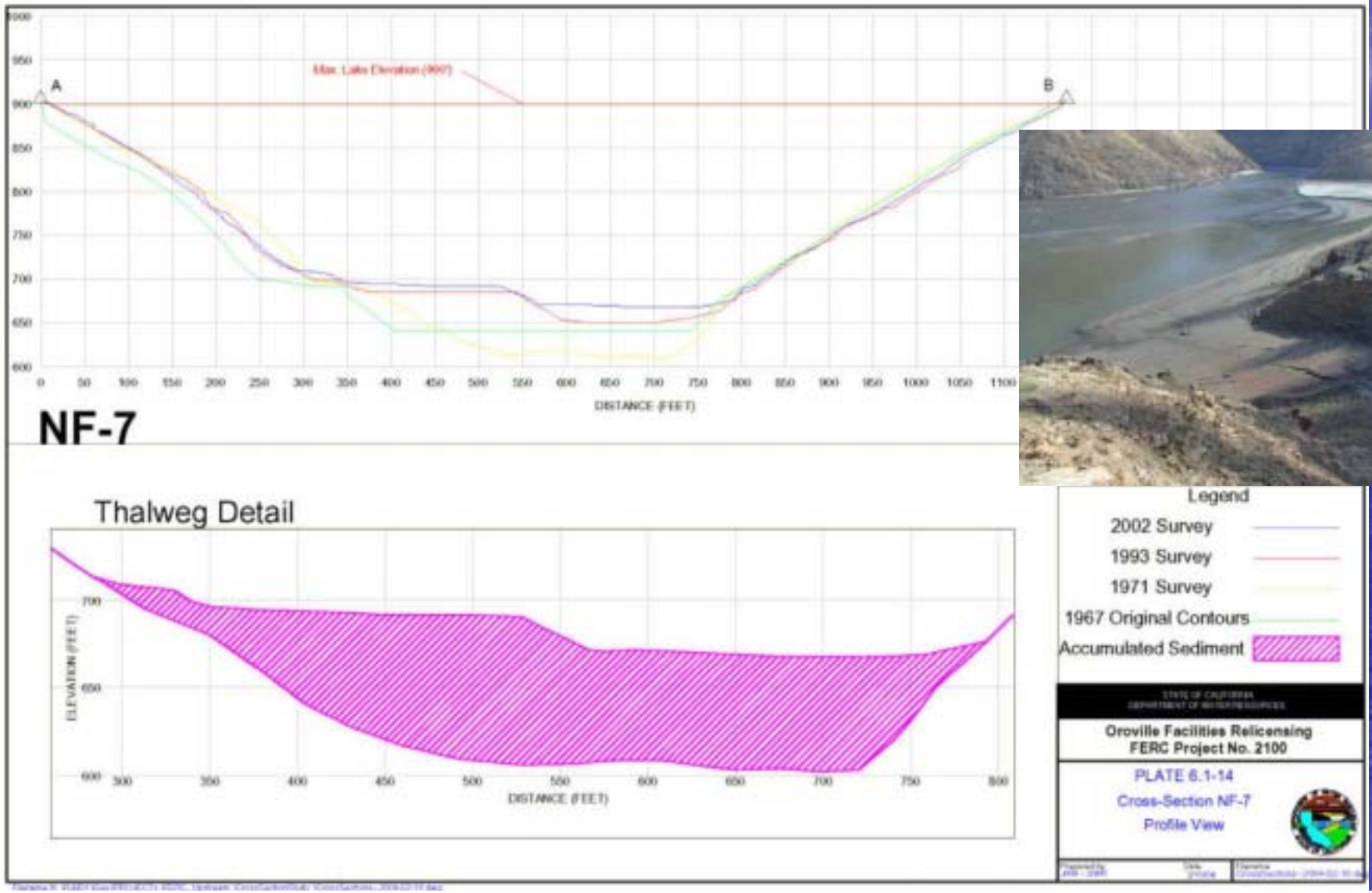
Pre-dam Conditions – Lower Middle Fork



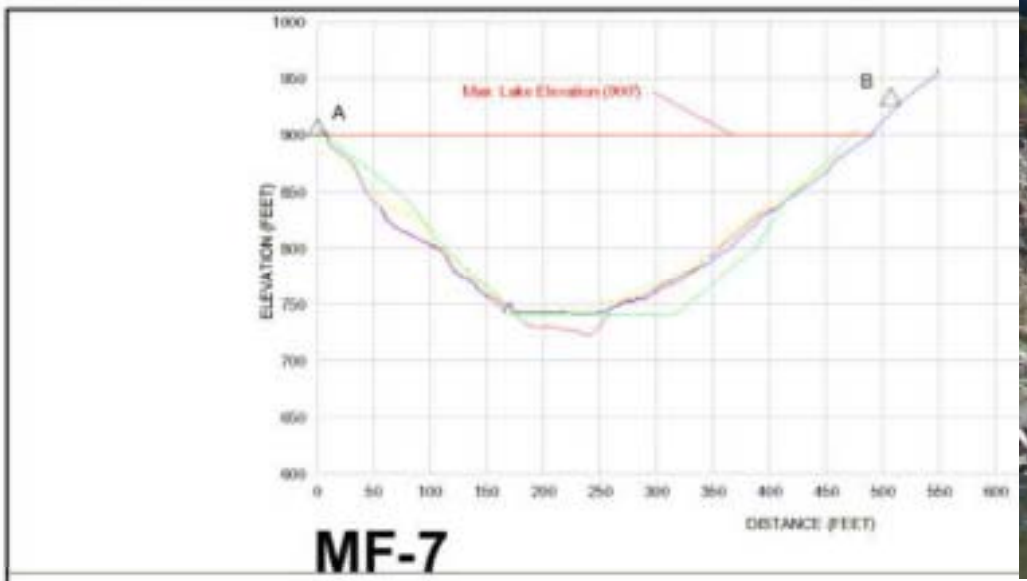
Cross Section Bathymetry Below Fluctuation Zone

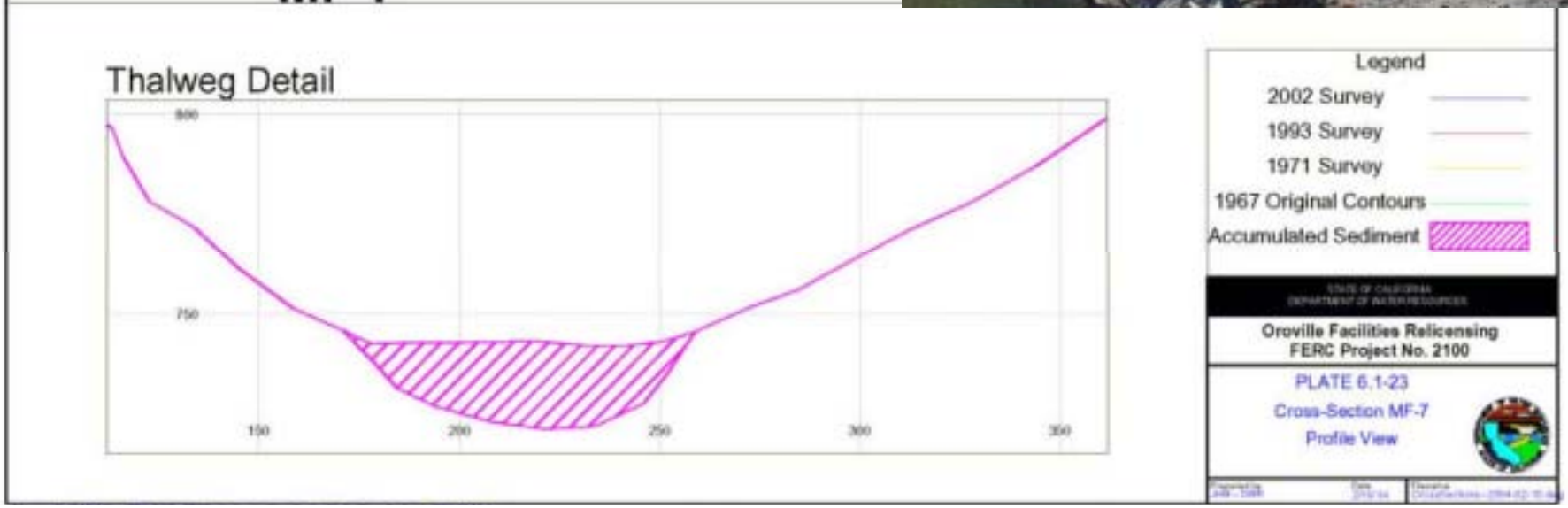


Cross Section Bathymetry Lower Fluctuation Zone



Cross Section Bathymetry Upper Fluctuation Zone





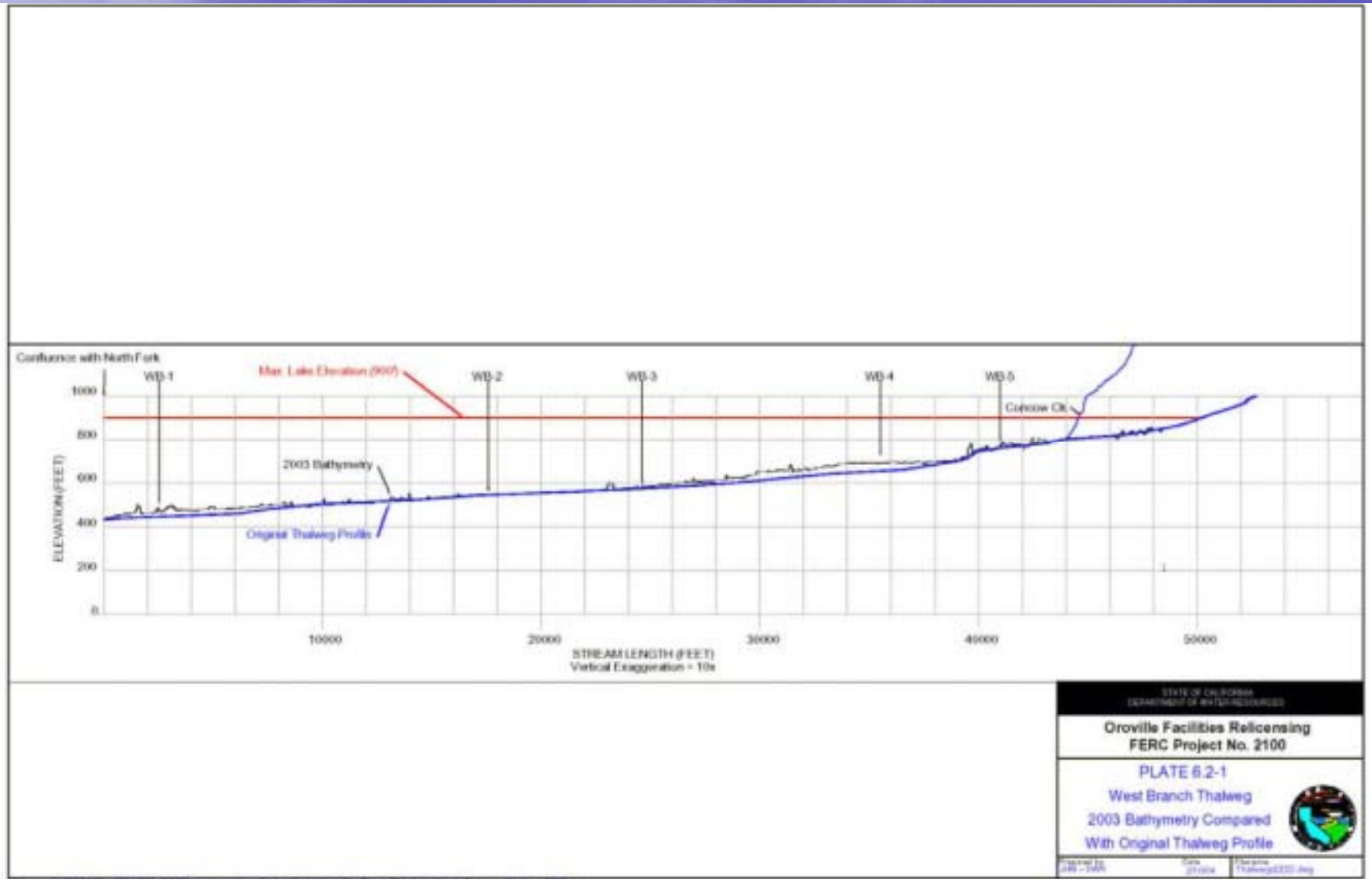
Cross Section Deposition Areas and Accumulation Rates

		Accumulation Rates							
Cross section	Thalweg Deposition (sq.ft.)	Start Year	Ending Year	Depth (ft.)	ft. / yr.	Start Year	Ending Year	Depth (ft.)	ft. / yr.
WB-1	1,000	1967	2002	21	0.60	1993	2002	9	1.00
WB-2	3,900	1967	2002	23	0.66				
WB-3	1,200	1967	2003	17	0.47				
WB-4	2,500	1967	2003	28	0.78				
WB-5	0								
FR-1	5,600	1967	2002	26	0.74				
NF-2	11,000	1967	2002	25	0.71	1994	2002	10	1.25
NF-3	8,400	1967	2002	27	0.77	1994	2002	5	0.63
NF-4	1,700	1967	2002	25	0.71	1994	2002	13	1.63
NF-5	7,700	1967	2002	37	1.06	1994	2002	18	2.25
NF-6	17,300	1967	2002	49	1.40	1993	2002	14	1.56
NF-7	26,800	1967	2002	90	2.57	1993	2002	20	2.22
NF-8	6,400	1967	2002	54	1.54	1993	2002	49	5.44
NF-9	900	1967	2002	10	0.29	1993	2002	3	0.33
MF-1	3,800	1967	2002	25	0.71	1994	2002	10	1.25
MF-2	3,600	1967	2002	43	1.23	1994	2002	8	1.00
MF-3	3,500	1967	2002	16	0.46	1994	2002	8	1.00
MF-4	3,800	1967	2002	37	1.06	1994	2002	10	1.25
MF-5	4,100	1967	2002	44	1.26	1993	2002	9	1.00
MF-6	18,700	1967	2002	90	2.57	1993	2002	9	1.00
MF-7	1,300	1967	2002	21	0.60				
MF-8	0								
SF-1	1,200	1967	2002	17	0.49				
SF-2	2,200	1967	2002	27	0.77				

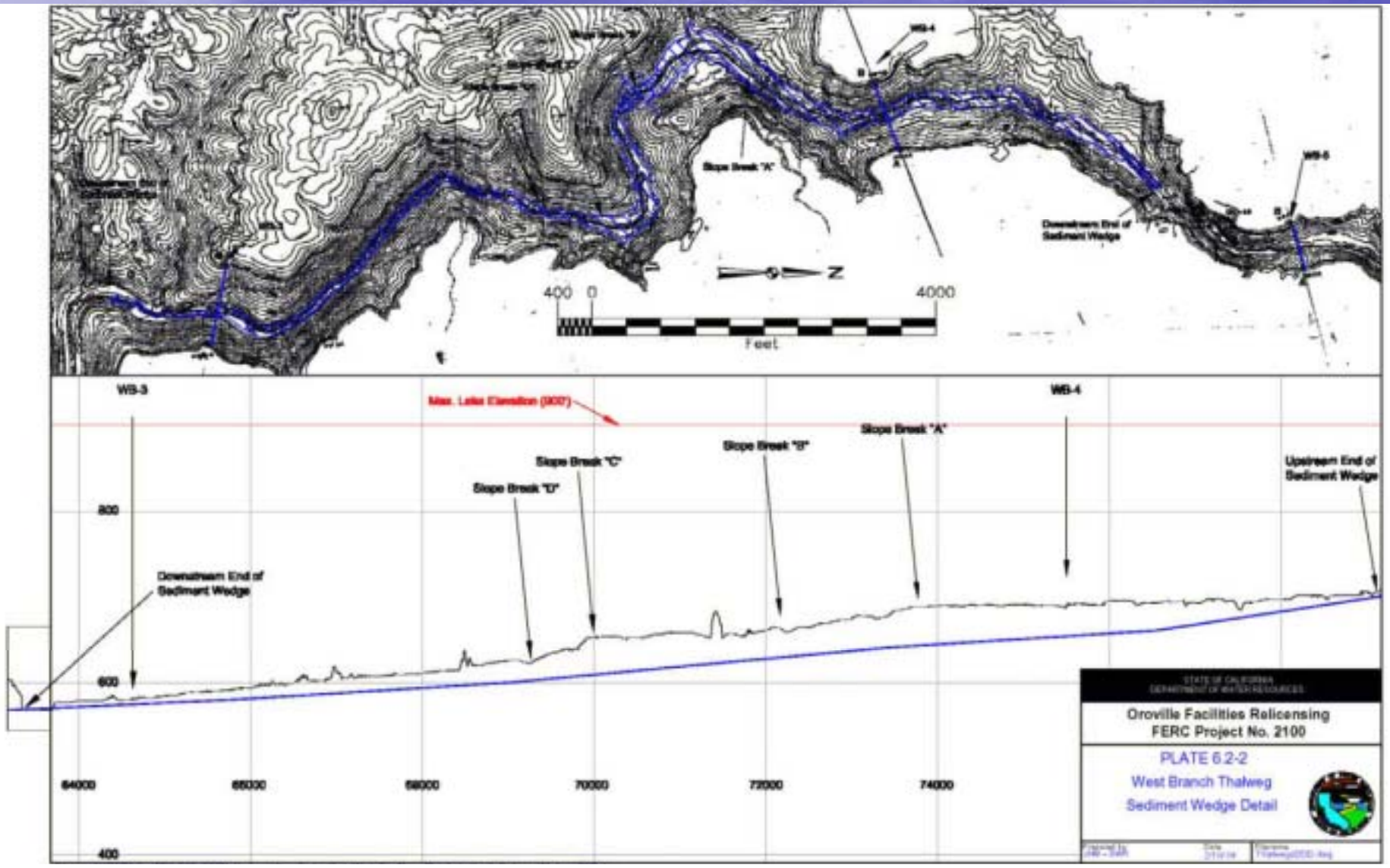
NOTE

Shaded areas identify cross-sections that are located primarily within the Fluctuation Zone.

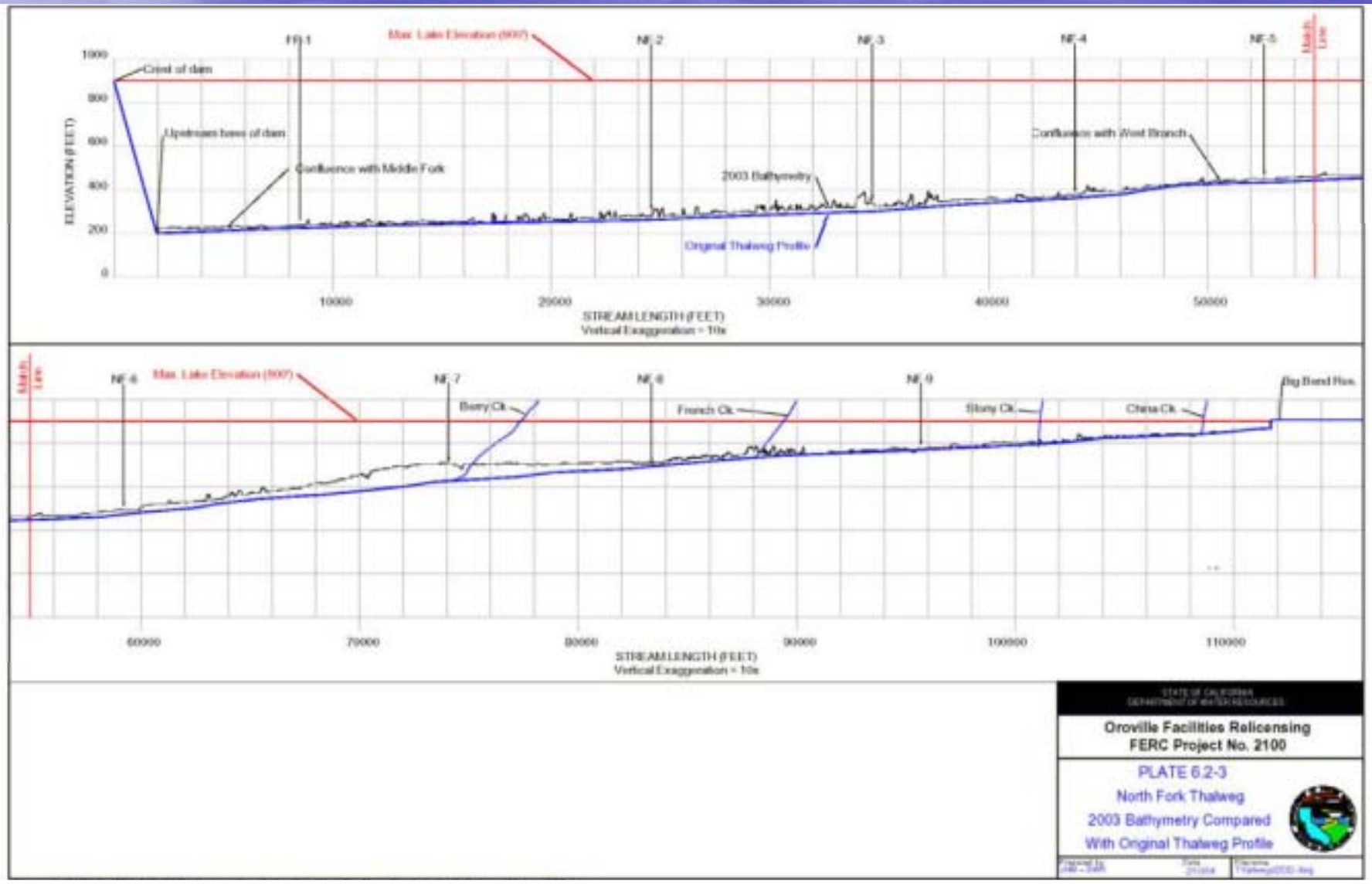
Thalweg Investigation
West Branch



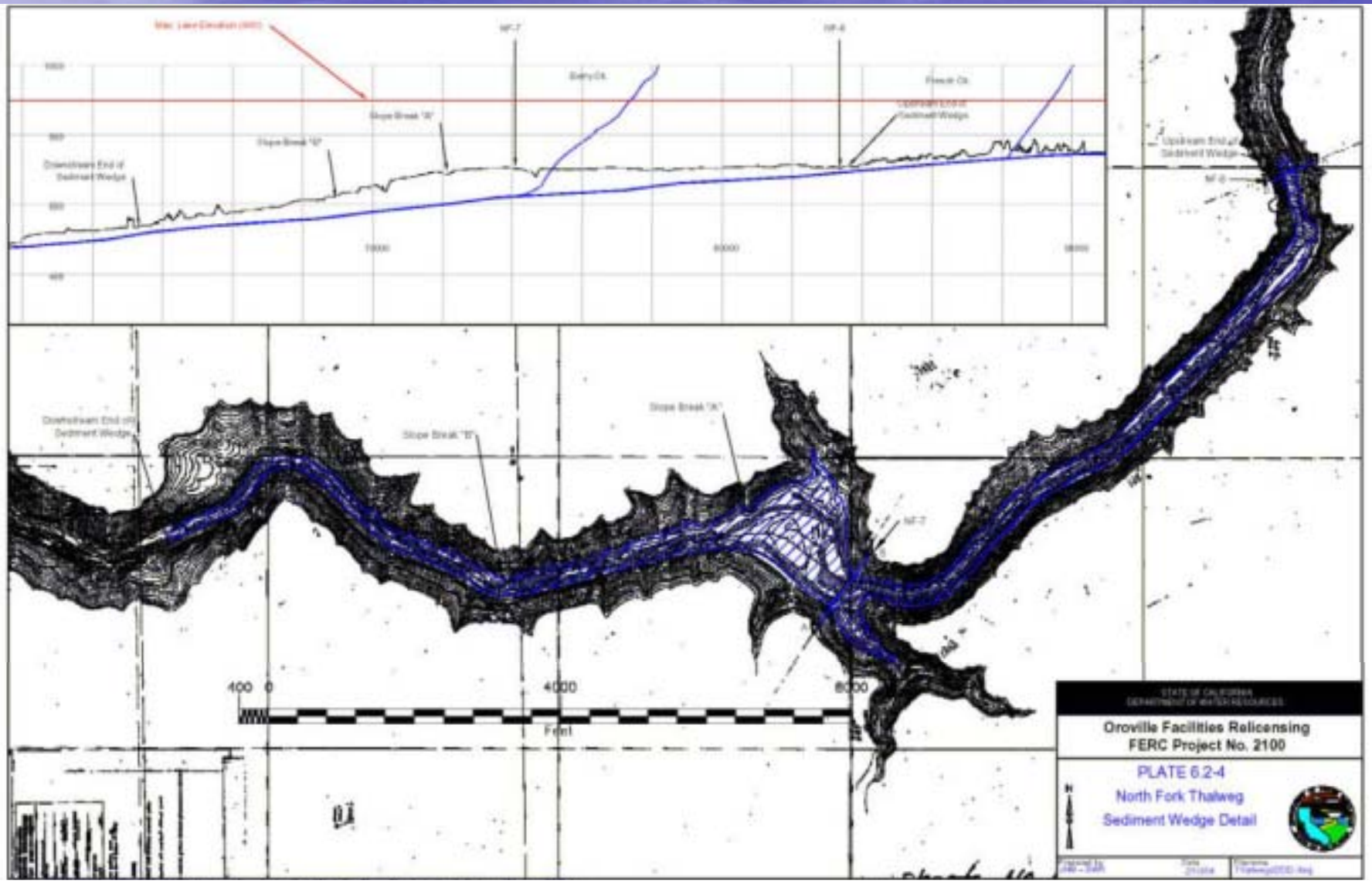
Thalweg Investigation
West Branch



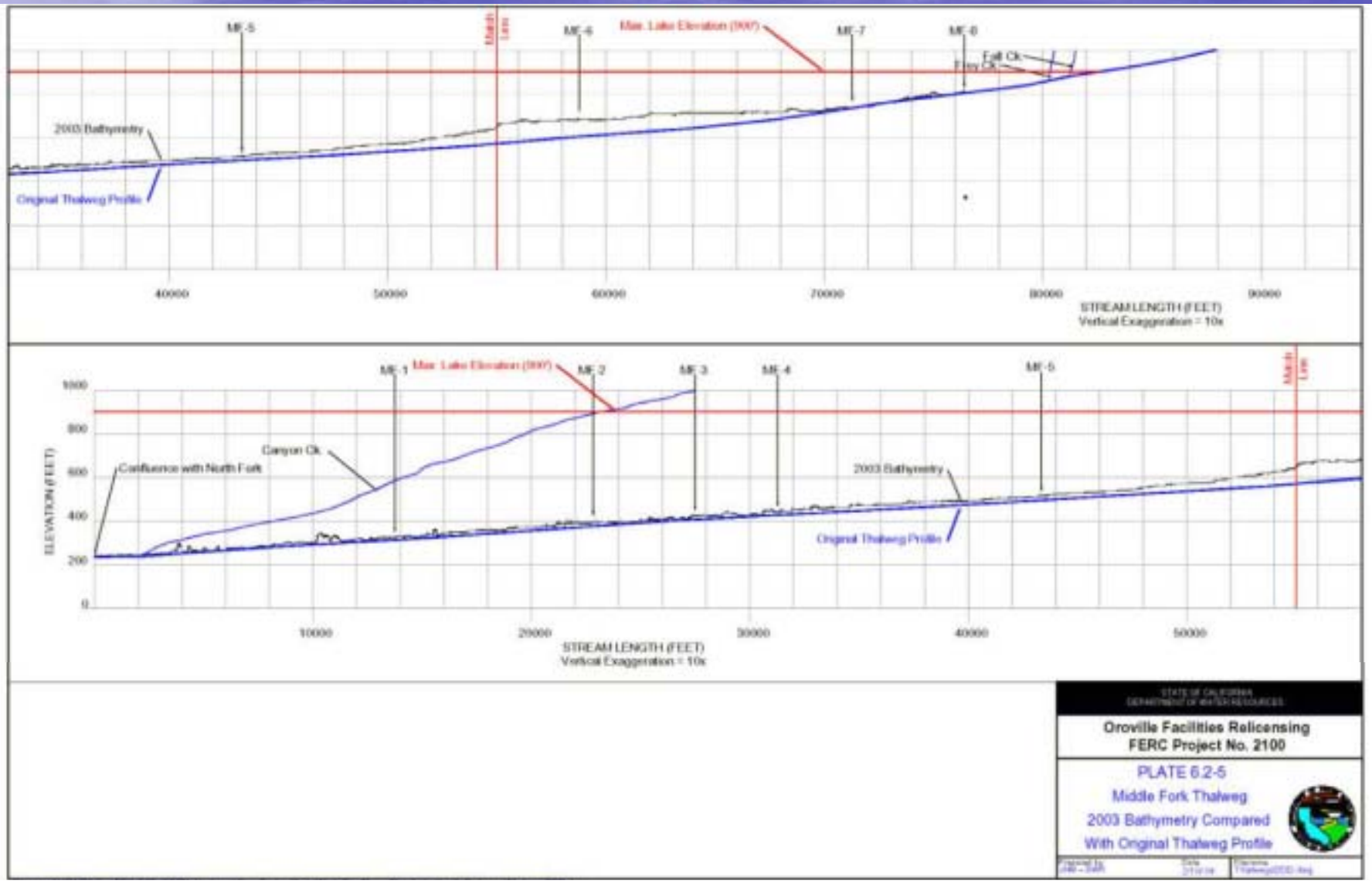
Thalweg Investigation
North Fork



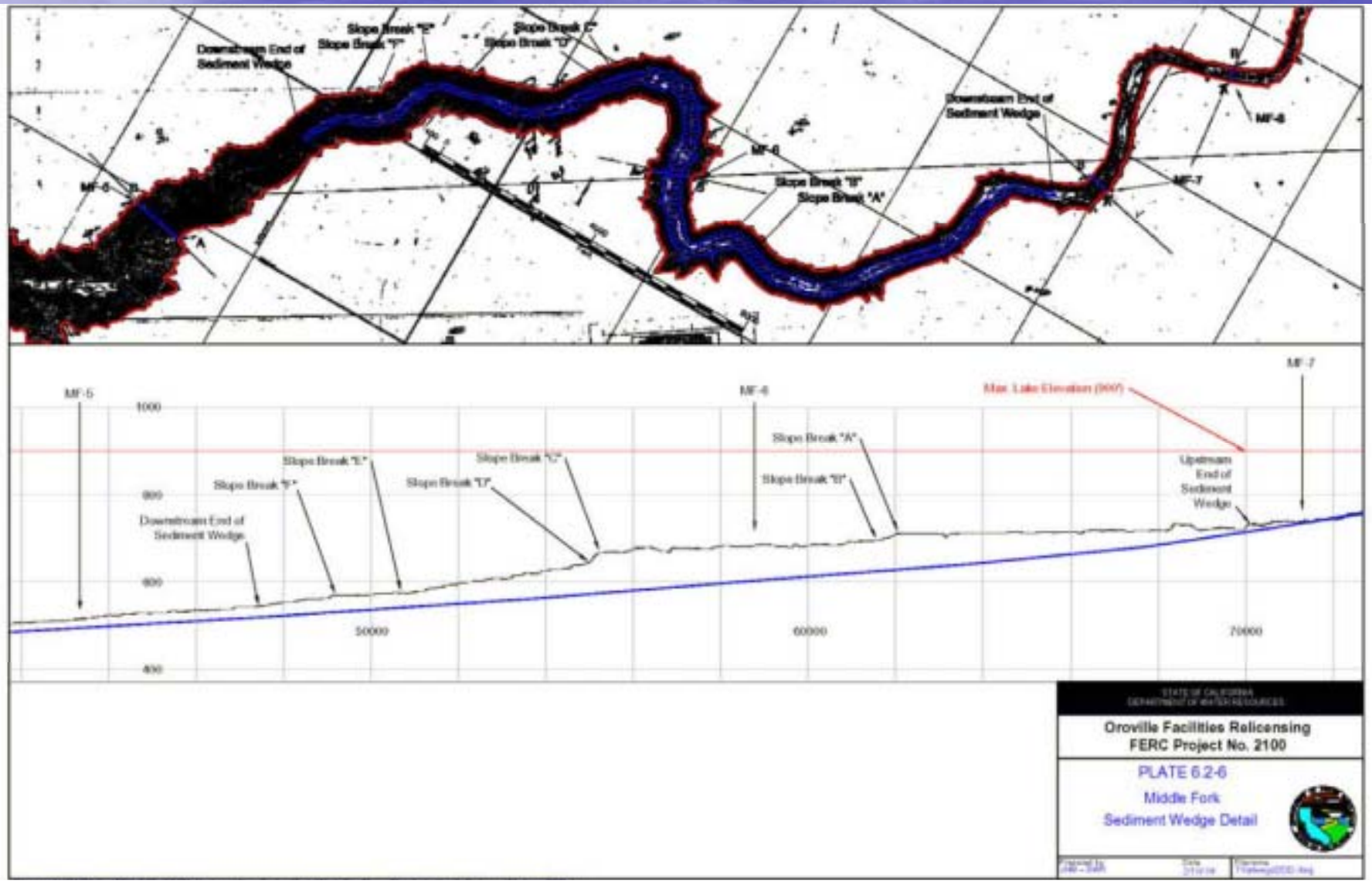
Thalweg Investigation
North Fork



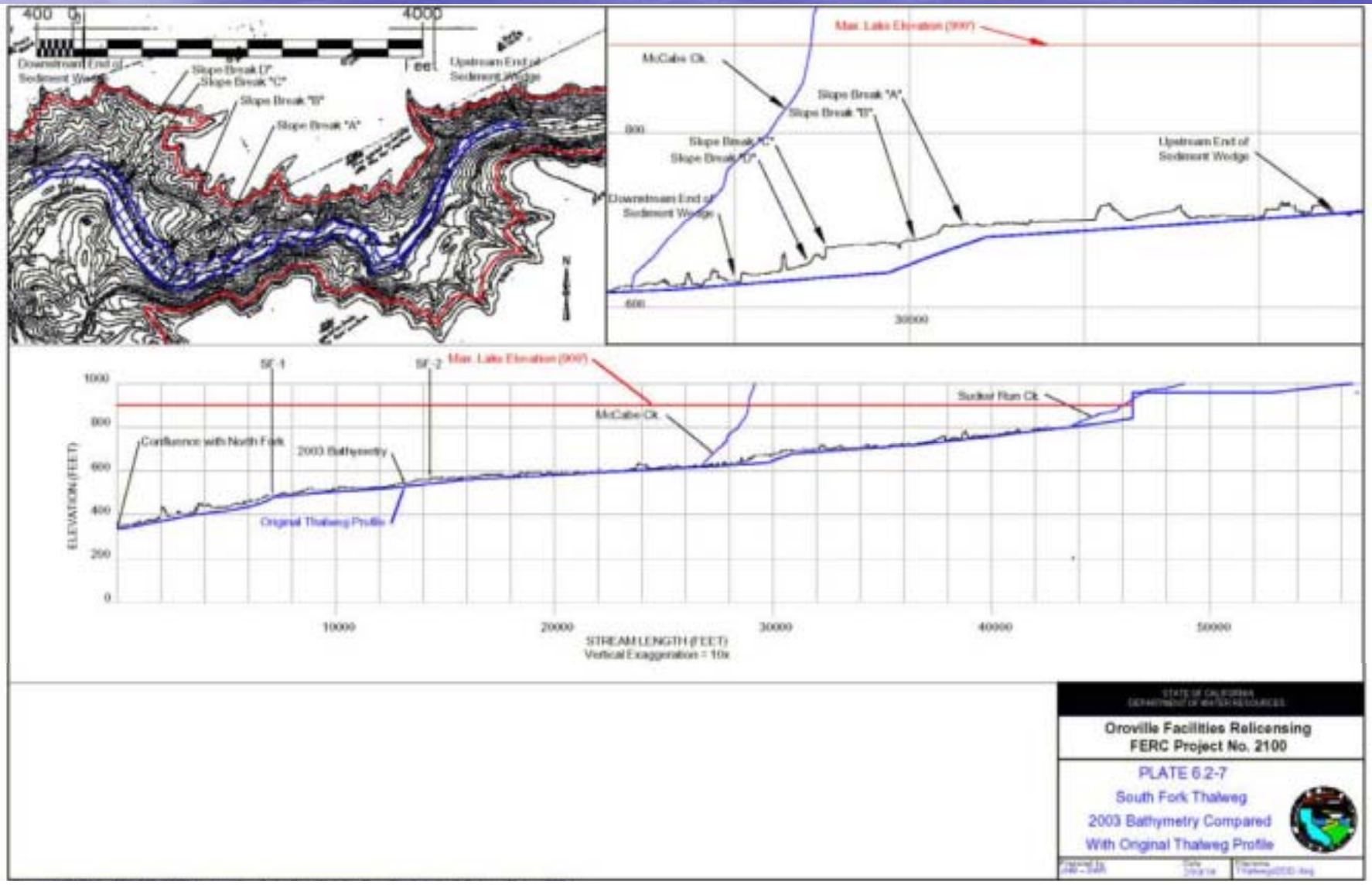
Thalweg Investigation
Middle Fork



Thalweg Investigation
Middle Fork



Thalweg Investigation
South Fork



Sediment Wedges